PORTABLE FIRE HYDRANT AND SYSTEM USING SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application Nos. 60/496,498 and 60/496,514, both of which were filed on August 20, 2003. The disclosure of these provisional applications is incorporated by reference herein.

FIELD OF THE INVENTION

[0002] The present invention relates to portable fire hydrants and systems using the same.

BACKGROUND OF THE INVENTION

[0003] Conventional fire fighting systems include an underground water main grid that is linked to numerous fire hydrants positioned above ground. The fire hydrants are typically made from cast iron or steel, and are dedicated to a particular grid location. While such systems have proven to be satisfactory for some purposes, they have some disadvantages. For instance, since the hydrants are constructed of extremely hard materials and are disposed above ground, they present a safety hazard. Automobiles or other vehicles can strike the fire hydrants causing damage to either or both the vehicle and the fire hydrant. If the fire hydrant is damaged, water pressure in the water main may decrease. Similarly, people can inadvertently come into contact with permanently mounted fire hydrants and injure themselves.

[0004] Additional disadvantages arise because fire hydrants are generally disposed curb side on a side walk. For instance, the amount of parking space that is available is decreased. In

cold regions, snow must be removed from the area surrounding the hydrants. Further, since conventional fire hydrants are accessible, they are often opened for recreational purposes, especially in higher temperature climates. Opened hydrants can result in low water level or water pressure that can negatively affect nearby fire fighting or normal business / household usage.

[0005] Because of these disadvantages, it has been suggested in the past that a portable fire hydrant be used. One such fire hydrant is disclosed in U.S. Patent No. 5,901,738, the disclosure of which is incorporated by reference herein. A portable fire hydrant may be carried by a fire department and installed on a water main to provide fire fighting water. Since a portable fire hydrant is not permanently installed, it will unlikely be accidentally contacted by vehicles or people. Also, since it is removable, it need not be disposed curb side. It could, for example, be attached to a water main via an access port located in the middle of the street. This would free up parking space, decrease the possibility of a vehicle blocking access to the water main, and reduce the likelihood of tampering. And snow is generally removed from the streets expeditiously.

SUMMARY OF THE INVENTION

[0006] The present invention is directed to portable fire hydrants and systems using portable fire hydrants. Some of the preferred portable fire hydrant embodiments employ hydraulics for at least one of the following functions: physically connecting the fire hydrant to a water main, sealing the fire hydrant to a water main, and operating a water main valve to permit water to flow through and out of the portable fire hydrant. In accordance with one preferred embodiment, there has now been provided a portable fire hydrant comprising a hydrant body, a hydraulic cylinder coupled to the hydrant body, and a water main engagement mechanism coupled to the hydrant body. The water main engagement mechanism may comprise at least one locking member that cooperates with an actuator, extending from the hydraulic cylinder, to move between a first position to a second position. The portable fire hydrant may be physically connected to a water main when the locking member is in the second position.

[0007] In accordance with another preferred embodiment, there has now been provided a portable fire hydrant comprising a hydrant body, a water main engagement mechanism coupled to the hydrant body, and a water main sealing mechanism coupled to the hydrant body. The engagement mechanism can include at least one locking member that is capable of moving from a non-engagement position to an engagement position. The sealing mechanism preferably includes a distensible seal. And the engagement and sealing mechanisms may be interconnected, so that actuation of one of the mechanisms results in actuation of the other.

[0008] In accordance with a third preferred embodiment, there has now been provided a portable fire hydrant comprising a hydrant body and a bladder seal radially distensible from the hydrant body that can effectuate a water-tight seal between the portable fire hydrant and a water main component.

[0009] The present invention further provides a portable fire hydrant system comprising a portable fire hydrant and an engagement mechanism for securing the portable fire hydrant to a water main pipe that contains a hydrant valve. The engagement mechanism includes a hydrant connector affixed to the hydrant body that is securable to a water main independently from actuation of the hydrant valve.

[0010] Portable fire hydrant systems having a water main location device and/or security device are also provided by the present invention. In accordance with one preferred embodiment, there has now been provided a portable fire hydrant system comprising a water main pipe configured for receiving a portable fire hydrant, an access to the water main pipe, and an electronic signaling device for identifying the location of the access. In accordance with another preferred embodiment, there has now been provided a portable fire hydrant system comprising a water main pipe configured for receiving a portable fire hydrant, an access to the water main pipe, and a cover spanning the access that includes a locking mechanism that can be electronically or magnetically deactivated.

[0011] These and various other features of novelty, and their respective advantages, are pointed out with particularity in the claims annexed hereto and forming a part hereof. However, for a better understanding of aspects of the invention, reference should be made to the drawings which form a further part hereof, and to the accompanying descriptive matter, in which there are illustrative embodiments. Although numerous embodiments have and are described herein, the invention disclosed includes various combinations of those embodiments, and it will be appreciated that in combining embodiments, not all features of one embodiment have to be included within all of the features of another embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Figure 1 is a perspective view of a street having a water main access in the form of a manhole;

[0013] Figure 2 is partial cross-sectional view of a manhole, and a manhole cover having a locating device affixed to one of its surfaces;

[0014] Figure 3 is a cross-sectional view of a one preferred security device embodiment in accordance with the present invention;

[0015] Figure 4 is a cross-sectional view of another preferred security device embodiment;

[0016] Figure 5 is a perspective view of a preferred portable fire hydrant embodiment provided by the present invention;

[0017] Figure 6 is a partial cross-sectional view of a portable fire hydrant, in accordance with the present invention, affixed to a water main;

[0018] Figure 7 is a partial cross-sectional view of one preferred water main engagement mechanism utilizing hydraulics;

[0019] Figure 7B is a detailed view of Figure 7 indicated by the broken line area designated 7b;

[0020] Figure 8 is a partial cross-sectional view of a second preferred water main engagement mechanism and a water main sealing mechanism;

[0021] Figure 8B is a detailed view of Figure 8 indicated by the broken line area designated 8b;

[0022] Figure 9 is a partial cross-sectional view of a portable fire hydrant embodiment having a water main engagement mechanism interconnected with a main sealing mechanism;

[0023] Figure 9B is a detailed view of Figure 9 indicated by the broken line area designated 9b;

[0024] Figures 10-16 are partial cross-sectional views of alternate water main engagement mechanisms that do not require hydraulics for actuation;

[0025] Figures 17-21 are cross-sectional views of exemplary seal embodiments useful in connection with the water main engagement mechanisms of the present invention;

[0026] Figure 22 is a partial cross-sectional view of a water main sealing mechanism embodiment according to the present invention, which does not require hydraulics for actuation;

[0027] Figure 23 is a cut-away view one preferred lateral valve and shoe coupling embodiment provided by the present invention;

[0028] Figure 24 is a cut-away view of a second preferred lateral valve and shoe coupling embodiment provided by the present invention; and

[0029] Figure 25 is a cut-away view of a third preferred lateral valve and shoe coupling embodiment provided by the present invention.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0030] The present invention relates to portable fire hydrants and systems using such hydrants. When a fire is reported, locating a water main source that is close to the fire is a primary concern. One of the features provided by the present invention is a water main location

device that is capable of transmitting a locating signal to a responding fire company. Besides geographical data, the location device may also transmit and receive other information. By way of example, and with reference to Figures 1 and 2, a water main access in the form of a manhole 1 can be located via the location device. An exemplary location device 3 is secured to the underside of a manhole cover 5. In one preferred embodiment, location device 3 includes a radio frequency (RF) transmitter. Another preferred location device 3 includes a global positioning satellite instrument. Although the location device is shown being secured to manhole cover 5, it may alternatively be secured to other nearby underground structures, such as, for example, a water main pipe, or to nearby above ground structures, such as a utility pole.

[0031] Once a chosen water main access is located, a fire fighter must remove the manhole cover and any items obstructing access to the underground water main. To prevent unauthorized entry into the manhole, the present invention also provides a security device. Figure 3 illustrates one preferred security device—a lockable cover plate 7 that resides beneath a manhole cover 5. Cover plate 7 employs locking pins 9, for example, that extend radially outward in their locked position to prevent removal of the cover plate. An electronic keypad 11 is located on a top surface 13 of cover plate 7. When the correct code is entered, locking pins 9 retract and allow cover plate 7 to be removed. Instead of electronic deactivation, magnetic technology can be used to unlock cover plate 7, for example, by retracting locking pins with a magnet. Figure 4 shows a cover plate 15 with locking pins 17 that can be retracted magnetically by exposing the locking pins to an appropriate magnetic field. A back-up deactivation mechanism may also be employed, such as a mechanical combination or key lock. Such back-up deactivation mechanisms may also serve as the primary mechanism, while electronic and magnetic technologies provided back-up deactivation. Furthermore, a manhole cover itself may employ security features in accordance with the present invention, so that a separate cover (e.g., cover plate 7) is not required.

[0032] With free access to the water main, a portable fire hydrant according to the present invention can be connected to the water source. Figures 5 and 6 show one preferred portable fire hydrant 19 before and after connection to a water main stand pipe 20. The connection preferably employs both a water main engagement mechanism and a water main sealing mechanism. The engagement mechanism provides mechanical integrity (i.e., securement); the sealing mechanism provides a water-tight seal.

[0033] Referring now to Figures7 and 7B, one preferred engagement mechanism uses hydraulics. Portable fire hydrant 19 includes a hydrant body 23 having a hydraulic cylinder 25 extending centrally from a top region 27. Hydraulic cylinder 25 includes an actuating rod 29, a

piston 31 to drive actuating rod 29 downward, and a spring 33 for returning actuating rod 29 upward to a resting position when hydraulic pressure is removed from piston 31. A hand pump 35 is affixed to the hydrant body for generating and applying hydraulic pressure to piston 31. Although hand pump 35 is shown permanently affixed to hydrant body 23, a portable fire hydrant can be designed to accept a removable hand pump or other auxiliary pump, such as, for example, an electric or battery operated pump that is either portable itself or connected to a fire fighting vehicle.

[0034] A pair of opposing locking members 37 are located in a bottom region 36 of hydrant body 23. A different number and configuration of locking members can also be used. Each of locking members 37 includes a locking pin 39 that is threaded into a spring plunger 41. A retaining nut 43 keeps the engagement mechanism assembly within hydrant body 23. The locking members are depicted in a non-engagement position, with locking pins 39 retracted to be at least flush with the hydrant body's outer surface 45. When a force is applied to spring plungers 41, a spring 42 is compressed, and locking pins 39 extend outward to engage a water main pipe or pipe fitting, such as a grooved pipe connector. One manner of applying such a force to spring plungers 41 is via hydraulically operated actuating rod 29. Other actuator types, such as fins or gears, could also be used. And pneumatic or mechanical operators can also be employed as an alternative to hydraulics.

[0035] In a preferred embodiment, and as shown in Figures 7 and 7B, a collar 47 having a camming surface 49, defined by a taper, is disposed on actuating rod 29. Collar 47 can be affixed to actuating rod 29 in a number of ways, including, for example, with a dowel pin, by threading, and by welding. Alternately, the actuating rod itself could be machined to provide a camming or otherwise interaction surface, so that a collar is unneeded. Operating hand pump 35 causes hydraulic pressure to be exerted against piston 31 to drive actuating rod 29 downward. As the actuating rod moves downward, the camming or tapered collar surface 49 increasingly applies force to spring plungers 41 causing locking pins 39 to move from their non-engagement position to their engagement position.

[0036] When hydraulic pressure is removed from piston 31, spring 33 returns actuating rod 29 to its original position, and springs 42 return locking pins 39 to their non-engagement position. The portable fire hydrant can then be removed from the water main.

[0037] Another portable fire hydrant embodiment 53 is illustrated in Figures 8 and 8B. Hydraulic pressure is used to actuate both a water main engagement mechanism and a water main sealing mechanism in this embodiment. The engagement mechanism features that are similar to the embodiment shown in Figures 7 and 7B will have the same reference numeral.

The sealing mechanism includes a bladder seal 55 that is distensible with pressured hydraulic fluid 57 disposed in a pair of hydraulic cylinders 59 that are aligned with locking members 37. Bladder seal 55 is preferably annular in shape, and also continuously disposed around the circumference of the hydrant body. Other bladder geometries and a bladder seal defined by multiple discrete bladder pockets can also be used.

[0038] Each of hydraulic cylinders 59 includes a spring plunger 61, a piston 63 having a threaded connection to spring plunger 61, a return spring 65, and a retaining nut 67. An actuating rod collar 69 has a camming surface 71 defined by a double taper: a first taper 73 for actuating the water main sealing mechanism, and a second taper 75 for actuating the water main engagement mechanism. Operating hand pump 35 causes hydraulic pressure to be exerted against piston 31 to drive actuating rod 29 downward. As the actuating rod moves downward, the first tapered surface 73 applies a force to spring plungers 61 and pistons 63. Piston displacement pressurizes hydraulic fluid 57 within cylinders 59, and forces the fluid through an orifice 79 in retaining nut 67 to distend bladder seal 55. The second tapered surface 75 actuates the engagement mechanism in a similar manner to the description accompanying the embodiment shown in Figures 7 and 7B. The geometry and relative positioning of the first and second tapers to the respective spring plungers cause engagement and sealing to occur substantially simultaneously. But the camming surface of the collar, or camming surface on an actuator itself without a collar, can be modified to alter the sequencing and manner of engagement and sealing.

[0039] Portable fire hydrants having interconnected engagement and sealing mechanisms are also provided by the present invention. For example, and with reference to Figures 9 and 9B, hydrant body 81 comprises a pair of opposing hydraulic cylinders 83 that are associated with locking members 85 and that also communicate hydraulic fluid 87 to a distensible bladder seal 89 through a fluid conduit 91. Each of hydraulic cylinders 83 includes a spring plunger 93 connected to a piston 95, a return spring 97, an override spring 99, and a locking pin 101. Displacement of spring plungers 93 and pistons 95 causes locking pins 101 to extend radially outward to an engagement position to secure the hydrant body to a water main pipe or fitting. This displacement also sufficiently pressurizes hydraulic fluid 87, located in cylinders 83 and fluid conduits 91, to distend bladder seal 89 to effectuate a water-tight seal. As shown in Figure 9B, such displacement can occur from downward movement of an actuating rod 103, which employs a distally located collar 105. Collar 105 has a camming surface 107 that interacts with springs plungers 93. The actuating rod 103, in Figure 9B, is extended via a hydraulic hand pump 109; other means can equally be used.

[0040] The actuating rod in the portable fire hydrant embodiments shown in Figures 7-9 can also open a water main valve to permit water to flow through the portable hydrants. For example, and with reference to Figure 6, the actuating rod within the portable fire hydrant embodiments can engage a second actuating rod 300 disposed within a vertical stand pipe 20 extending from a water main 314. The second actuating rod 300, when acted upon by the actuating rod within a portable fire hydrant, displaces a hydrant valve 320 from a valve seat 324, so that water can flow from the water main, up through the vertical stand pipe, and then through the portable fire hydrant. One or more return springs 330 can be connected to the second actuating rod 300 for reseating the hydrant valve 320 when hydraulic pressure is removed from the mechanism.

[0041] Thus, three functions can be accomplished through one simple up and down motion of a hydraulic hand pump (or other pump). By way of example, and with a fire hydrant embodiment similar to that shown in Figure 9, the first three strokes of a hand pump engage locking pins to prevent vertical removal of the hydrant while allowing 360 degree rotation; strokes four to six distend a bladder seal; and strokes seven through twenty-eight open a water main valve. These three functions are preferably accomplished in less than 20 seconds.

[0042] The water main engagement and sealing mechanisms depicted in Figures 7-9 rely on the interaction of an actuating rod and collar to apply pressure to components of the mechanisms (e.g., locking pins and distensible seals). In alternate embodiments contemplated by the present invention, forces can be applied to mechanism components directly with hydraulic fluid that is pressurized by a hand pump or other auxiliary pump. That is, an intervening actuating rod or other mechanical member is not required. For example, secondary hydraulic cylinders or hydraulic fluid conduits in fluid communication with the main hydraulic cylinder can be employed. Such a configuration can provide a fail-safe system that allows for a total operation shut down—hydrant valve closed and disengagement of the portable fire hydrant from the water main—in the event of a failure.

[0043] Referring now to Figures 10-16, a number of alternate water main engagement systems and mechanisms are shown, which do not necessarily employ the assistance of hydraulics. These engagement mechanisms generally comprise two main components: 1) a hydrant connector affixed to the hydrant body; and 2) a pipe connector that is capable of being affixed to a water main pipe. As shown in Figure 10, hydrant connector 111 includes a shaft 113 extending vertically within a hydrant body 115, and a plurality of spaced apart fins 117 extending from the shaft. In certain preferred embodiments, three fins are used. The fins can be formed integrally with the shaft, or can be formed separately and then attached to the shaft via

welding, for example. Each of fins 117 has a threaded portion 119 that is matable with a threaded portion 121 on a pipe connector 123. To attach a portable fire hydrant employing this mechanism, a fire fighter aligns the two threaded portions and rotates the hydrant until he obtains a secure connection.

[0044] Another hydrant connector 125, shown in Figure 11, includes a number of lugs 127 extending from an outer surface 129 of the hydrant body. Lugs 127 may extend from a continuous ring disposed on the hydrant body; lugs 127 may extend as discrete members. A corresponding pipe connector 131 employs a corresponding number of multi-directional slots—preferably including a vertical slot (not shown) terminating into a horizontal slot 133. The lugs are dropped into the individual vertical slots, and the hydrant is rotated such that the lugs are located in the horizontal slot to prevent the hydrant from moving upwardly and off of the water main pipe. Preferably, one or more of the horizontal slots has a camming surface, such as, for example, a tapered surface, that the lugs travel on so that the connection tightens during rotation.

[0045] Figure 12 illustrates a hydrant connector 135 that is generally an extension of a hydrant body 137 having a plurality of multi-directional slots 139 formed therein. Pipe connector 141 employs pins 143, each of which is insertable into one of multi-directional slots 139. As noted above, at least one of the multi-directional slots preferably has a camming surface to provide a more secure hydrant-water main connection. A similar engagement mechanism is shown in Figure 13, where a hydrant connector 144 employs multi-directional slots 145 formed in a ring 147 on the hydrant body instead of in a parallel extension member. Ring 147 may have a discontinuous configuration around the hydrant body so that slots oriented in only a single direction—horizontal, for example—can optionally be employed. The mating pipe connector has similar features (and like reference characters) to those in Figure 11.

[0046] Referring now to Figure 14, another exemplary engagement mechanism is shown, including a hydrant connector 149 that is matable with a pipe connector 151. Hydrant connector 149 comprises multiple (preferably two) toggle clamps 153 affixed to the outer hydrant surface. Pipe connector 151 has a groove 157, which can be continuous or include discrete groove sections. Toggle clamps 153 each have an arm 159, and a latch 161 on the end of the arm that can fit into groove 157. When the clamps are moved from an open position to a closed position, the arms retract so that a tight connection is accomplished.

[0047] Another engagement mechanism embodiment is illustrated in Figure 15. The mechanism includes a hydrant connector 163 having a spring-loaded hinge 165 with a latching member 167, such as a ball, situated at its end. A matable pipe connector 169 has a groove 171 that latching member 167 fits into. With pipe connector 169 secured to a water main pipe, the

hydrant is placed just above it, and with a minimal amount of force and downward displacement, latching member 167 moves outward through compression of spring 173 and then snaps into groove 171. To remove or reposition the hydrant, a firefighter simply rotates hinge 165 outwardly, preferably without the assistance of any tools, until latching member 167 disengages groove 171.

[0048] Referring now to Figure 16, an exemplary engagement mechanism includes a hydrant connector 175 having a first lug 177 and a pipe connector 179 having a second lug 181. The respective lugs 177, 181 are designed to fit together. This type of engagement mechanism is typically referred to as a Stortz-type connector. Although the lugs shown are L-shaped, other geometries are encompassed by the present invention.

[0049] Seals are preferably employed between hydrant connector and pipe connector surfaces. The seals facilitate a tight mechanical engagement and provide a water-tight seal between the hydrant and water main. Figures 17-21 depict a number of preferred seal types and arrangements. Although the seals are depicted as being employed with only one type of matable connectors (a connection similar to that shown in Figure 11), the seals can be adapted for employment in other types of matable hydrant and pipe connectors. And more than one seal may be used in some circumstances.

[0050] Referring now to Figure 17, a flat rubber face seal 183 is shown disposed between respective horizontal surfaces 185, 187 of a hydrant connector 125 and pipe connector 131. Figure 18 shows a Stortz-type lip seal 189 that is preferably made from a moldable rubber material. A thin cross-section of the lip seal allows easier deflection/compression of the seal. And water pressure inside the hydrant body helps create a tighter seal. A spring energized TPFE face cup seal 191 is illustrated in Figure 19. The leaf-type spring inside cup seal 191 forces the opposing sides of the seal to diverge against the respective horizontal surfaces 185, 187 of a hydrant connector and pipe connector. As shown in Figure 20, the cup seal 191 of Figure 19 can also be positioned between respective vertical surfaces 193, 195 of the mating hydrant connector and pipe connector. Lastly, Figure 21 shows an o-ring energized TPFE radial band seal 197 between the respective vertical surfaces 193, 195.

[0051] Like the alternate water main engagement systems shown in Figures 10-16, alternate water main sealing mechanisms do not necessarily require the assistance of hydraulics. For example, and with reference to Figure 22, a portable fire hydrant includes a hydrant body 203 having a sidewall 205, a conduit 207 disposed in hydrant body 203, and a bladder seal 209 seated in a recess 211 in sidewall 205. Various liquid and gas mediums can be communicated through conduit 207 to distend or inflate bladder seal 209. A valve stem (not shown) may extend

from the top of the hydrant body so that compressed air or water, for example, can be introduced into passage way ..

[0052] Water main piping systems typically employ an underground hydrant valve that is actuated by a hydrant feature and that permits water to flow through and out of the hydrant during fire fighting. To facilitate service of permanent or portable fire hydrants (e.g., portable fire hydrants provided by the present invention), a lateral valve and shoe coupling (see 340 in Figure 6) can be disposed between the water main and a connective pipe that extends vertically from the water main for connection to a fire hydrant. The lateral valve 344 can be actuated, for example, via a hand-manipulated actuating rod 348 inserted through a manhole cover (or other water main access) and adjacent the vertical connective pipe. Pneumatics or hydraulics can optionally be used for actuating the lateral valve. Figures 23-25 illustrate three preferred lateral valve and shoe coupling embodiments, each comprising a lateral valve 212 and a connection 213 for a hydrant vertical stand pipe. The embodiments shown vary according to their configuration and the number of pipe connections available.

[0053] It is to be understood that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only. Accordingly, changes may be made in detail, especially in matters of shape, size and arrangement of features within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.